REMOVAL OF THE SUPERIOR CERVICAL GANGLION FOR THE RELIEF OF GLAUCOMA, WITH REPORT OF A CASE.

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PART I.—By C. W. CUTLER.

GLAUCOMA is a disease of a variable nature, at times so subtle and insidious as to escape the trained observer. Again, so emphatic in its traits that the picture impresses one with the facility with which it must be recognized. This protean character brings with it resemblances to other conditions, between which a distinction is of vital importance.

It is natural that such a disease should be left to the specialist where this is possible, but the need of prompt diagnosis and treatment is as urgent as it is in appendicitis or in mastoiditis. Moreover, a recent step in the surgical treatment of the disease has brought it more prominently to general notice, and justifies the attempt to describe some of its more striking features.

Glaucoma is a name given to a group of symptoms dependent on an increase of intraocular tension. The cause of this condition may be obstruction of the normal outlet at the angle of the anterior chamber, or increase of the quantity of fluid secreted by the ciliary body; beyond this we need not go for the moment into the intricacies of theory. The method used for the determination of increased tension is palpation of the eyeball with the index-fingers through the closed lid, the patient looking downward. It is obvious that small differences may escape the examiner, and, as tension is not constant, frequent examinations, at different times of the day, are necessary.

The results of this increased tension are impairment of function, shown by cloudy vision and narrowing of the field of vision, especially on the nasal side, colored rings or halos around a light, and pain in and around the eye of greater or less severity. This constitutes the prodromal stage, and may occur at intervals of days or weeks before the disease evolves suddenly, after fatigue or excess or excitement. The emotional element is often prominent, pain increases rapidly, vision fails, the pupil is dilated and immobile, the eye injected, the cornea hazy with a dull, steamy surface, the anterior chamber is shallow, the eye is hard to the touch. This attack of inflammatory glaucoma is terribly acute; it has been compared to strangulated hernia, and unless relief is immediate, vision is lost, and the state of absolute glaucoma follows. Between this extreme and the prodromal condition there are various degrees, classified, for convenience, as simple glaucoma, when the tension rises slowly, and is never very high, and as chronic inflammatory glaucoma, when the process is prolonged, but more active than in simple glaucoma. It is convenient to divide glaucoma into two groups, primary and secondary to some other disease of the eye; but the tension and its results are the same in both instances, and it is probable that many cases of so-called primary or idiopathic glaucoma may with care be traced to subtle inflammatory changes, the existence of which is masked by the rapid development of the disease.

The inevitable result of the tension, whether it is slight and transitory or fulminating, is excavation of the optic nerve which furnishes the characteristic ophthalmoscopic feature and leads to the loss of vision.

An important group of cases for the purposes of this paper is that of hæmorrhagic glaucoma in which tension is accompanied or preceded by hæmorrhages in the retina. This occurs in patients with arteriosclerosis or with chronic nephritis. Here the glaucoma is usually acute, and is not, as a rule, amenable to the older method of treatment, as the sudden lowering of tension following iridectomy may have disastrous results.

In another group, classed by some as simple glaucoma, by others as optic atrophy with excavation, the rise of tension is so slight as often to escape the observer; the excavation is not deep, and a positive diagnosis may be impossible except for the occasional subjective symptoms and brief tension after emotional experiences or stress. Such cases are influenced least of all by iridectomy, and are prone to go on to optic atrophy and blindness in spite of all treatment.

The cause of intraocular tension must be sought in diminished excretion or increased secretion of the fluid contents of the eyeball. The theory commonly accepted is that of Knies and Weber. They found that in many glaucomatous eyes the root of the iris is adherent to the sclera, closing the chief channel for the escape of intraocular fluid through the ligamentum pectinatum and canal of Schlemm. This adhesion is probably produced in several ways. Swelling of the ciliary body presses the root of the iris forward so that it is in contact with the sclera. This may be brief and periodic, accounting for the transitory symptoms of the prodromal stage, or it may be complete and permanent, thus producing the severer forms of the disease. Dilatation of the pupil by means of atropine or one of the weaker mydriatics, such as homatropine or cocaine, may induce an attack of glaucoma in eyes predisposed to the disease. This is because the iris, where the sphincter is paralyzed, retracts towards the periphery in folds which tend to fill up the sinus or angle of the anterior chamber.

Priestly-Smith has measured many eyes which have been enucleated for glaucoma. He finds that the lens is relatively large or the eye small, thus narrowing the passage between the edge of the lens and the ciliary processes through which fluid must pass. Any excess of fluid in the vitreous, then, or any increase in its density, hindered in its normal channel, will press the lens, ciliary processes, and iris forward and close the exit. Panas and Rochon-Duvigneaud ("Sur le Glaucome," Paris, 1899) believe that the first step in the process is an œdema of the vitreous resulting from the vascular degeneration which they found in glaucomatous eyes.

It is clear that if the ciliary body secretes too much fluid, the same end is reached; and the earlier theories of von Graefe and Donders were akin to this assumption, and Laqueur (*Deutsches Archiv für klinische Medicin*) has returned to the view that the origin of the disease is a secretory neurosis of the sympathetic system.

It is not probable that changes in blood-pressure have any direct influence on intraocular pressure, but senile changes in the vascular walls, arteriosclerosis, and obliterating endarteritis are found in a great many eyes enucleated for glaucoma, and are believed to have an important influence on the disease, and especially on the excavation and atrophy of the optic nerve.

It must be noted that there are very few opportunities for the pathological examination of eyes in a state of acute glaucoma, and there is no conclusive evidence that the obstruction in the anterior chamber and the vascular changes are primary and causal.

It is obvious that the mechanical obstruction of the outlet must dam back the current, and in secondary glaucoma this is cause enough for the clinical picture; but primary glaucoma is another matter, and suggests very forcibly the existence of a nerve mechanism governing the relations of the walls of the eyeball to its fluid contents, controlling the intake and outlet, and the tone of the muscular walls as we assume must be the case, although positive proof is lacking there also, in the vasomotor mechanism and in other hollow viscera.

That retention of the contents of the eye must cause glaucoma has been proven (if it was not self-evident) by numerous experiments on the eyes of rabbits by Bentzen (*Archiv für Ophthalmologie,* Band xli, 4, Abt.), and by Koster (*Archiv für Ophthalmologie,* Band xli, 2, Abt., also in Lubarsch and Ostertag, Ergebnisse der allgemeinen Pathologie des Auges, 1901); but that this condition is the only cause, or, in primary glaucoma, the origin of the disease, is by no means proven, and is a matter much more difficult to investigate.

For nearly fifty years, since von Graefe described the operation (*Archiv für Ophthalmologie,* Band iii, 2. Abt.), iridectomy has been practised, and it is still the only measure offering relief in certain cases. Notwithstanding this long period, men of large experience are still at variance not only as to the way in which the operation acts,—for the theory is almost as obscure as it was in von Graefe's day,—but as to its efficacy in certain cases, especially of simple glaucoma.

It is impossible to do more in this place than to state very briefly the case for and against iridectomy in order that an idea may be had as to the prognosis.

In acute inflammatory glaucoma the results are best. Haab ("Das Glaucom und seine Behandlung," 1902) gives the results of iridectomy in thirty-one eyes observed for two years or more: seven became blind, 22 per cent.; four cured relatively, 13 per cent.; twenty cured completely, 64 per cent.

Of thirty-seven eyes with chronic inflammatory glaucoma, sixteen became blind, 43 per cent.; ten were cured relatively, 27 per cent., and eleven were cured completely, 30 per cent.

Of seventy-six eyes with simple glaucoma, twenty-two became blind, 29 per cent.; twenty-two were cured relatively, 29 per cent., and thirty-two were cured completely, 42 per cent.

Of ten eyes with hæmorrhagic glaucoma, six became blind and four were improved.

Of fifteen eyes treated only with drugs (eserine and pilocarpine), nine were blind and six relatively helped.

By relative cure, Haab means that useful vision was retained, in spite of relapses, by the use of eserine or pilocarpine or by a later sclerotomy. These statistics may be taken as representing the average of a number of observers, although there are wide limits.

It is now necessary to turn from this very superficial review to a consideration of the latest claimant.

It is much too early to attempt to compare sympathectomy with iridectomy. The cases now watched with more or less enthusiasm must be allowed to stand the criticism of at least two years' impartial observation before definite conclusions can be reached. The following record is offered, then, as a basis for future study.

The history begins April 30, 1897. A. G. R., aged fifty-six years; several members of his family became blind from unknown causes. The patient has had muscular rheumatism and pains in and around the joints without signs of acute inflammation for years, and has suffered much with neuralgic pains in the face. There is marked arteriosclerosis; the heart and kidneys are normal.

In 1893, at the homœopathic hospital, he was given some medicine for hiccough, and soon after had severe pain in both eyes. Vision was much impaired, and everything seemed colored red. This lasted two days, and sight returned gradually. For the past year and a half attacks of cloudy vision have been frequent, with rings around the lights and more or less pain. For about a year, chromatopsia has been very frequent and distressing.

The predominant colors are red, orange, and violet, in that order. These colors remain, after looking at objects of the same color, as persistent after-images. Blue seems to leave a violet after-image. When the eyes are closed he often sees orange or red; he formerly saw all colors but blue. He distinguishes plainly between these bright colors and the dull rings seen around lights. At times red or orange seems to break like a rocket, as he expresses it. Again it would settle gradually on what he was looking at, blotting it out with a clear, beautiful color, not in the least foggy, or there might be a fog without color. It did not seem that red vision followed fatigue with one color more than another.

Often it would come after a perimetric examination with a white object, suffusing the entire field, and at times it is present on awakening from sleep or in a dark room. Yellow and green do not seem to have been noticed. In relative scotomata and at the edges of absolute scotomata and the margins of the field where vision is variable, the test object, white or colored, is seen red.

These phenomena were lessened by eserine and pilocarpine, and after sclerotomy they disappeared for a time. Later, they reappeared. Now, since the sympathectomy, the subjective sensations are absent, although the red edges of scotomata in the field are constant. Color perception is normal. Night-blindness has been a prominent symptom. Improvement with adaptation has been comparatively slight; continued reading was at his best times almost impossible, the retina quickly becoming fatigued.

Perception of least differences is considerably below the normal, and at times day-blindness is marked, as would be expected from the condition of the optic nerve.

Usually the eyes are staring, and the upper lids are retracted, so that the entire cornea is exposed.

At the time of the first examination, April 30, 1897, vision in both eyes $= {}^{20}/_{100}$, tension $+ 1$, pupils normal, reacting to light, anterior chamber and iris normal, media clear, retina normal in appearance, vessels very slightly narrowed, nerves excavated to a depth of about 3 D, vessels lost at the edge to reappear at the floor; there is no apparent difference in the excavation at different parts of the nerve to account for the loss of the upper part of the field.

May 2, after eserine had been used for three days, vision, R. E. $= {}^{20}/_{30}$, L. E. $= {}^{20}/_{40}$. Tension normal in both eyes. This continued under eserine or pilocarpine for nearly two months, when vision began to fail rapidly, varying from ${}^{20}/_{40}$ to ${}^{20}/_{100}$. At times tension slightly raised, more often normal.

Anterior sclerotomy was performed and vision became ${}^{20}/_{20}$ in both eyes, and remained so with some fluctuations for nearly three months, when the sight failed more rapidly than before, and on December 29, 1897, vision was ${}^{15}/_{200}$ in the right eye and ${}^{10}/_{200}$ in the left. On January 6, 1898, iridectomy was performed on the right eye. The operation and recovery were uneventful, and vision improved somewhat, but not enough to encourage the patient to submit to an operation on the left eye.

The hospital records of this period are unfortunately lost; but shortly after this he disappeared, and was not seen again until June of last year.

June 2, 1901. R. E., fingers at three feet, tension + ½ to + 1; L. E., absolute glaucoma; V. 0, tension + 2.

June 5. After eserine for three days, V. R. E. = $^{20}/_{200}$ +. The fields of vision at different periods may be seen better than described. Pain constant and severe in both eyes. Appearance of nerves and vessels much the same as previously noted. In the left eye the lens was sclerosed.

The superior cervical ganglion of the right sympathetic was excised at St. Luke's Hospital, June 10, 1901. During the operation there was no noticeable dilatation of the pupil on excitation of the ganglion, nor was there any change when it was divided.

June 11. Right pupil slightly contracted, reacts to light, much hyperæsthesia of skin of face and pain on pressure in both eyes, especially the right. Conjunctiva congested, photophobia marked, probably due to the ether. Flashes of red light in right eye.

June 12. R. E. Tension — ½, vision $^{20}/_{30}$. Field of vision larger than before the operation, slight ptosis, some difficulty in swallowing, choking sensation, pain in right side of face and head, impaired phonation.

June 19. Vision, R. E. $^{20}/_{30}$ +, Tn. Ptosis of right lid, retraction of left lid, sweating only on left side of face, slight right enophthalmus. The right optic nerve seems less pale than before the operation.

November 18. Since leaving the hospital, vision has remained the same, $^{20}/_{30}$ +, at repeated examinations, with different test types and under varied conditions. About three weeks ago a few letters of $^{20}/_{20}$ were read. To-day vision is $^{20}/_{30}$, full. Ptosis less marked.

May, 1902. Nearly a year after the operation, vision remains $^{20}/_{30}$. He reads an hour quite easily, and thinks he could read more, but prudently stops before he is fatigued.

August 25.—Vision $^{20}/_{30}$; reads fine print easily. The field is narrower, especially for red, showing that the optic nerve is becoming more atrophic.

The secondary effects of the operation were paralysis of the right side of the larynx, the sternomastoid, trapezius, and the right half of the tongue; reaction of degeneration was present. This condition gradually diminished, so that four months after the operation little or no discomfort was experienced, and now there are no signs of the nerve lesions except some paræsthesia of the side of face and neck and occasional sharp pain in the temporomaxillary articulation or the parotid on beginning to masticate, and on taking acid substances into the mouth.

The examination of the excised ganglion by Dr. Wood, pathologist to the hospital, is as follows:

Specimen, five centimetres long, one-half centimetre in diameter. At one point, for one and one-half centimetres, is a thickening. Sections through whole length of specimen show large ganglion cells. In these cells the chromophilic bodies do not show the normal size and arrangement, and many cells show small granules of pigment. A growth of connective tissue is between the ganglion cells. Nerve fibres are normal.

It is evident that if glaucoma is relieved by removal of the ganglion, the hypothetical process active as a factor in the etiology must be of a chronic irritative nature, or it may be considered an exaggeration of the physiological function. Sclerosis of the ganglion with the formation of new connective tissue might act in this way by compressing the ganglion cells in its contraction, but the objection occurs at once: If this is true, why is glaucoma not more common, since sclerosis and the deposit of pigment in the ganglion cells seem to be a frequent occurrence in arteriosclerosis and senile conditions in general? (Graupner, *Ziegler's Beiträge*, xxiv, p. 253.)

The literature of this subject has become so extensive that a brief allusion to it must suffice. A complete list of cases reported would serve no useful purpose, as the information most desired will be obtained only from the later reports of these cases, and not from an announcement of operations performed. We have had recourse chiefly to Ziehe and Axenfeld's excellent monograph, "Sympathicus-Resection beim Glaucom." Marple has tabulated these cases concisely, with some more recent reports, in an article to which reference should be made.

The conclusions of Ziehe and Axenfeld, while conservative, are by no means unfavorable.

In four cases of acute inflammatory glaucoma, the results of the operation were negative. Iridectomy is much to be preferred in these cases.

Of three cases of hæmorrhagic glaucoma, Abadie's was blind, pain and tension were relieved. In Dor's case, glaucoma followed three attacks of serous iritis. After iridectomy, there were two severe intraocular hæmorrhages. A month later the ganglion was excised, and rapid improvement of tension and vision followed. During the three and one-half months' period of observation there was another light attack of inflammatory glaucoma. In the third case (Albertotti) the record is so confused that definite conclusions cannot be drawn. Pain seems to have been relieved, but tension became high again after one year and a quarter. In the second eye of the same case, sympathectomy was evidently performed as a prophylactic measure. The eye remained normal.

Among seventeen cases of chronic inflammatory glaucoma, eight were absolute. Pain and tension were relieved in three of these; of the remaining cases, five showed a distinct gain. In one (Demicheri), vision arose from $^1/_{50}$ to $^2/_3$; iridectomy had been ineffectual; in one eye there was absolute glaucoma, in the other high tension and distinctly atrophic spots in the iris; the field of vision was limited upward and outward. After sympathectomy, vision became $^2/_3$, field of vision and tension became normal, and remained so during three months' observation. The atrophic spots in the iris disappeared.

With the exception of the last surprising statement, this case, in its history and degree of improvement, resembles the one forming the basis of this article.

Of simple glaucoma, thirty cases are given, and eighteen of these may be said to have shown improvement, in some instances very marked, extending over periods of several months to a year, in others less brilliant and for varying times. Often the time of observation has been so brief that the records are valueless as yet. In four cases the disease advanced inexorably, not because of the operation, however, but in spite of it. It is, however, in desperate cases, as a forlorn hope and especially where iridectomy has failed, that sympathectomy deserves consideration; and as it is has been done chiefly in such cases, it is not just to compare the results with those following iridectomy, which is or should be performed at an early stage of the disease. In a recent article by Rohmer (*Annales d'Oculistique,* May, 1902), 114 cases, from various sources, are reported. The figures are distinctly favorable but by no means conclusive.

The risk is very slight; there have been no deaths, and the early secondary effects are temporary and avoidable. With regard to the late secondary effects we have little information.

In a table given by Wilbrand and Saenger (" Neurologie des Auges," Vol. i, p. 546), ten cases of sympathetic paralysis following wounds show four with trophic disturbances, the cheek being shrunken (*abgemagert*). Three of these cases, seen seven, nine, and ten years after the accident, still showed ptosis and narrowed pupil. This would indicate that the effect of the operation on glaucoma may also be of long duration.

In passing, a symptom may be mentioned, which, if proven to exist in certain cases of glaucoma, will help to distinguish such cases as are dependent on the influence of the sympathetic ganglion. We refer to retraction of the lids or von Graefe's sign, which in three cases of chronic glaucoma seen recently has been more marked than is usual in optic atrophy or impaired vision from other causes. It does not seem amiss to associate this symptom with the large, sluggish pupil and increased tension of glaucoma, since all are influenced by sympathectomy. In one case of unilateral glaucoma this sign is present only on the affected side. It is not as pronounced as it often is in Basedow's disease, but resembles the effects of cocaine. Von Graefe's sign is sometimes seen where there is no disease, and in normal eyes and in these cases it may be merely a result of the effort to see better, but the case in which it is present only on the side of the glaucoma is certainly suggestive.

Our case has not been one in which brilliant results might have been expected. All other measures had failed to give more than temporary relief. The appearance of the optic nerve was such that vision seemed compromised from causes secondary to the glaucoma. Its pallor and the total excavation gave little hope. The retinal vessels, however, were not notably contracted, and this fact may explain one of the ways in which sympathectomy acts—by improving the nutrition of the retina and nerve when the vessels are not irredeemably reduced.

The question suggests itself, whether the passive hyperæmia following vasomotor paralysis is of value to the tissues; but this is a point that must be left to the physiologist.

The increased vitality of the retina and nerve was shown by the disappearance of the distressing color sensations and after-images. The diminished pallor of the nerve seen by Ball and by Schmidt-Rimpler in a case of Basedow's disease and in our own case is striking, and makes it easier to accept the improvement claimed in a few cases of atrophy of the nerve not of glaucomatous origin. Such improvement, however, must be of brief duration and not sufficient to justify the operation.

Paralysis of the sympathetic also narrows the pupil, thus freeing the angle so often mentioned; besides this, it unquestionably softens the eyeball, even in the normal state, quite independently of its action on the pupil, in a way not yet understood.

It is apparent that glaucoma is a complex disease, not traceable to any single cause, and that excision of the sympathetic ganglion is a physiological antagonist to its most important symptoms. Whether this will be supported by clinical evidence in any number of cases, or whether the results will be of sufficient duration to justify the operation, only time will decide.

PART II.—By C. L. GIBSON.

On June 10, 1901, I removed the upper ganglion of the cervical sympathetic. Nitrous oxide and ether anæsthesia. Usual asepsis, including the use of rubber gloves. A straight incision running downward from the mastoid along the anterior border of the sternomastoid. The sheath of the vessels having been exposed, the vessels and pneumogastric nerve were reflected inward, and after some further dissection the sympathetic ganglion was found posterior to the aforementioned structures. A painstaking dissection of the connections of the ganglion was made before division of the nerve above and below. The wound was sutured without drainage and healed *per primam*. Convalescence was uneventful. He was allowed up on the ninth day, and discharged ten days later. Although the operation presents no extraordinary difficulties, several points are of interest.

In the hands of a competent surgeon familiar with work in this region of the body, it is a comparatively safe operation to perform on a patient who is in a fair condition of health. It is desirable to secure perfect aseptic conditions, for a failure of technique might involve considerable danger of septic infiltration in the deep planes of the neck.

The incision employed seems to me to give an admirable *exposé* of the field, and is to be preferred to that employed by Jonnesco and other European surgeons, that is parallel to the posterior border of the sternomastoid. A clear view is absolutely necessary; a suitable electric headlight may prove useful. I also found that a frequent douching of the wound with normal saline solution useful in restoring the identity of the structures when discolored with blood.

In subsequent operations, I shall not attempt to make so minute a dissection of the communicating nerves radiating from the ganglion, as it seems quite unnecessary, and subjects these filaments to unnecessary traumatism, which resulted in our case in transitory pareses of the pharynx, larynx, and tongue. There was also a temporary paresis of the trapezius;

this was caused, as we realized during the operation, by pressure of a retractor upon the spinal accessory.

It seems likely that these various disturbances that have also frequently been noted by other operators are caused by this direct violence of the neighboring nerves or communicating filaments rather than to interference with some of the physiological functions of the ganglion.

On the other hand, careful observation of the after effects of these operations may yield additional information to our rather vague understanding of the essential functions of the sympathetic ganglion.

The names of several individuals, Baracz, Abadie, Jaboulay, and Jonnesco, are identified with the evolution of the idea of attacking the cervical sympathetic by its section, or by its extirpation for the relief of glaucoma. To the latter we apparently owe the idea of the *removal* of the upper cervical ganglion, which he seems to have developed as a result of his original treatment of epilepsy by the removal of the entire cervical sympathetic on both sides.

His early recommendations (*Centralblatt für Chirurgie*, 1899, page 161) received only scant notice or sharp criticism, more particularly as they were presented in a manner that failed to inspire confidence. In the course of time cases were published from sources deserving of every respect, which tended to give the operation a certain standing. In New York conservatism was extreme, and many oculists were reluctant to yield to the persuasion of surgeons to whom this operation as published in the surgical literature had been known for some time. The case we have reported and one performed just before by Dr. Frank Hartley were, I believe, the first performed in this city. Quite recently, however, they have been performed frequently both by oculists and surgeons, and further valuable experience is to be expected. My own belief is that sympathectomy is destined to occupy a definite place in the treatment of this distressing condition, but its proper sphere is to be determined by the judgment of the ophthalmic surgeon.

To summarize our conclusions, it may be stated that in acute forms of glaucoma iridectomy must be considered the operation of choice, except where there is a tendency to intraocular hæmorrhage. In all chronic forms of the disease, the improvement to be expected from iridectomy is less, as the tension of the eye is less marked, until in simple glaucoma the results of the operation are at the most 50 per cent. of successes, while in the group of cases mentioned above, on the border-line between glaucoma and optic atrophy, iridectomy is of so little value that it has been given up by many ophthalmic surgeons.

In these cases, in hæmorrhagic glaucoma and in not a few cases where iridectomy has failed to give relief or has done positive injury in the first eye, sympathectomy may prove to be the more conservative operation, especially as there is no evidence to show that the removal of the superior cervical ganglion of the sympathetic has resulted in any injury to the human eye.

This case may be an exceptional one, but an operation that has such definite results, in even a limited number of cases, cannot be thought of lightly, and must be accepted as an important additional resource in a desperate condition.